

**What is claimed is:**

- 1) An optic probe comprising:
  - a tubular body having a hollow interior with a center axis and an axial length with opposite proximal and distal ends;
- 5 an optical sensing element at the distal end of the tubular body; and
  - a resilient seal between the optical sensing element and the distal end of the tubular body sealing the interior of the tubular body from an exterior environment of the probe.
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- 2) The optic probe of Claim 1, further comprising:
  - the seal engaging around a portion of the optical sensing element.
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- 3) The optic probe of Claim 1, further comprising:
  - the tubular body having an interior surface that surrounds the hollow interior and the seal engaging against the interior surface.
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- 4) The optic probe of Claim 1, further comprising:
  - the resilient seal being compressed between the optical sensing element and the tubular body.
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- 5) The optic probe of Claim 1, further comprising:
  - the optical sensing element being a reflective crystal having at least two surface areas that are oriented at an angle to each other.

- 6) The optic probe of Claim 1, further comprising:  
at least a portion of the optical sensing element having a conical  
shape.
- 5 7) The optic probe of Claim 1, further comprising:  
at least a portion of the optical sensing element having a frustum  
shape.
- 10 8) The optic probe of Claim 1, further comprising:  
a plurality of fiber optic cables extending through the interior of  
the tubular body, each cable having a proximal end adjacent the tubular body  
proximal end and an opposite distal end adjacent the tubular body distal end;  
and  
an optical assembly inserted into the tubular body interior  
15 adjacent the tubular body distal end, the optical assembly having a plurality of  
holes extending axially through the optical assembly and the distal ends of the  
plurality of fiber optic cables being positioned and supported in the plurality of  
holes.
- 20 9) The optic probe of Claim 8, further comprising:  
a temperature sensor in the tubular body interior.
- 10) The optic probe of Claim 9, further comprising:  
the temperature sensor being mounted on and supported by the  
25 optical assembly.

- 11) The optic probe of Claim 8, further comprising:  
a pressure sensor in the tubular body interior.
- 12) The optic probe of Claim 11, further comprising:  
5 the pressure sensor being mounted in the tubular body interior  
adjacent the optical assembly.
- 13) The optic probe of Claim 8, further comprising:  
the optical assembly having a first portion with an exterior  
10 surface that engages with the tubular body and a second portion that projects  
axially outwardly from the first portion and is spaced from the tubular body;  
the optical sensing element having an end surface that opposes  
the optical assembly and a cavity recessed into the optical sensing element  
from the end surface, and the optical assembly second portion extending into  
15 the cavity.
- 14) The optic probe of Claim 13, further comprising:  
a resilient seal between the optical sensing element end surface  
and the optical assembly first portion.
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- 15) The optic probe of Claim 8, further comprising:  
a transparent optical window mounted in the tubular body  
interior axially between the optical assembly and the optical sensing element.

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- 16) The optic probe of Claim 15, further comprising:  
the optical window and the optical sensing element being axially  
spaced from each other with there being a void in the tubular body between  
the optical window and the optical sensing element, and an opening in the  
5 tubular body communicating the void with the exterior environment of the  
probe.
- 17) The optic probe of Claim 15, further comprising:  
a resilient seal between the optical window and the distal end of  
10 the tubular body sealing the interior of the tubular body from the exterior  
environment of the probe.
- 18) The optic probe of Claim 1, further comprising:  
the distal end of the tubular body being a tubular tip guard  
15 secured to the tubular body, the tubular tip guard having a smooth, cylindrical  
exterior surface.
- 19) The optic probe of Claim 18, further comprising:  
the optical sensing element being contained in the tubular tip  
20 guard.
- 20) The optic probe of Claim 19, further comprising:  
the resilient seal being between the optical sensing element and  
the tubular tip guard.

- 21) The optic probe of Claim 1, further comprising:  
the resilient seal being an o-ring.
- 5           22) The optic probe of Claim 18, further comprising:  
the tubular tip guard having an opening exposing the optical  
sensing element to the exterior environment of the probe through the tubular  
tip guard opening.
- 10          23) The optic probe of Claim 1, further comprising:  
a cleaning cap on the tubular body distal end, the cleaning cap  
having an interior bore; and,  
the optical sensing element being inside the cleaning cap  
interior bore.
- 15          24) The optic probe of Claim 23, further comprising:  
the cleaning cap having an exterior surface; and,  
a seal mounted on the cleaning cap exterior surface.
- 20          25) An optic probe comprising:  
a tubular body having a hollow interior with a center axis and an  
axial length with opposite proximal and distal ends;  
a plurality of fiber optic cables extending through the interior of  
the tubular body, each fiber optic cable having a proximal end adjacent the

tubular body proximal end and an opposite distal end adjacent the tubular body distal end; and

an optical sensing element at the distal end of the tubular body,  
the optical sensing element having an end surface that opposes the distal  
5 ends of the plurality of fiber optic cables and the optical sensing element  
having a conical surface that is axially opposite the end surface.

26) The optic probe of Claim 25, further comprising:  
the conical surface being on a frustum shaped portion of the  
10 optical sensing element.

27) The optic probe of Claim 25, further comprising:  
an optical assembly inserted into the tubular body interior, the  
optical assembly having a plurality of holes extending axially through the  
15 optical assembly and the distal ends of the plurality of fiber optic cables being  
positioned and supported in the plurality of holes.

28) The optic probe of Claim 27, further comprising:  
a temperature sensor in the tubular body interior and supported  
20 on the optical assembly.

29) The optic probe of Claim 28, further comprising:  
a pressure sensor in the tubular body interior.

25 30) The optic probe of claim 29, further comprising:

the pressure sensor being mounted in the tubular body interior adjacent the optical assembly and the optical assembly being mounted in the tubular body interior for movement of the optical assembly relative to the tubular body and relative to the pressure sensor.

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31) The optic probe of claim 27, further comprising:

the optical sensing element end surface having a cavity that is recessed into the end surface and the optical assembly having a portion that extends into the cavity.

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32) The optic probe of Claim 27, further comprising:

a transparent optic window mounted in the tubular body interior in a position between the optical assembly and the optical sensing element.

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33) The optic probe of Claim 32, further comprising:

the optical window and optical sensing element being axially spaced from each other by a void in the tubular body interior between the optical window and the optical sensing element and an opening in the tubular body communicating the void with the exterior environment of the probe.

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34) The optic probe of Claim 25, further comprising:

the distal end of the tubular body being a tubular tip guard secured to the tubular body, the tubular body and the tip guard having a smooth, cylindrical exterior surface.

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35) The optic probe of Claim 34, further comprising:  
the optical sensing element being contained in the tubular tip  
5 guard.

36) The optic probe of Claim 35, further comprising:  
the tubular tip guard having an opening exposing the optical  
sensing element to an exterior environment of the probe.